CALIFORNIA HIGH SPEED TRAIN
TULARE COUNTY
CONTRACT PACKAGE 2/3
SUSPENSION VELOCITIES
BORINGS S0028R, S0067R & S0072R

Report 13296-01 rev 0

October 25, 2013

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TABLE OF CONTENTS

TABLE OF CONTENTS **3**

TABLE OF FIGURES **4**

TABLE OF TABLES **4**

INTRODUCTION **5**

SCOPE OF WORK **5**

INSTRUMENTATION **7**

SUSPENSION VELOCITY INSTRUMENTATION 7

MEASUREMENT PROCEDURES **10**

SUSPENSION VELOCITY MEASUREMENT PROCEDURES 10

DATA ANALYSIS **11**

SUSPENSION VELOCITY ANALYSIS 11

RESULTS **13**

SUSPENSION VELOCITY RESULTS 13

SUMMARY **14**

DISCUSSION OF SUSPENSION VELOCITY RESULTS 14

QUALITY ASSURANCE 15

SUSPENSION VELOCITY DATA RELIABILITY 16

Table of Figures

Figure 1: Concept illustration of P-S logging system 17
Figure 2: Example of filtered (1400 Hz lowpass) record 18
Figure 3. Example of unfiltered record 19
Figure 4: Boring S0028R, Suspension R1-R2 P- and S_H-wave velocities 20
Figure 5: Boring S0067R, Suspension R1-R2 P- and S_H-wave velocities 24
Figure 6: Boring S0072R, Suspension R1-R2 P- and S_H-wave velocities 28

Table of Tables

Table 1. Boring locations and logging dates 5
Table 2. Logging dates and depth ranges 16
Table 3. Boring S0028R, Suspension R1-R2 depths and P- and S_H-wave velocities 21
Table 4. Boring S0067R, Suspension R1-R2 depths and P- and S_H-wave velocities 25
Table 5. Boring S0072R, Suspension R1-R2 depths and P- and S_H-wave velocities 29

APPENDICES

APPENDIX A **SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS**

APPENDIX B **GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION RECORDS**

INTRODUCTION

Boring geophysical measurements were collected in three uncased borings located along the proposed alignment of the California High Speed Train, in Tulare County, California. Geophysical data acquisition was performed between September 4, 2013 and October 4, 2013 by Robert Steller and Victor Gonzalez of **GEO***Vision*. Data analysis was performed by Robert Steller and Victor Gonzalez. Report preparation was performed by Emily Feldman and reviewed by Robert Steller of **GEO***Vision*. The work was performed for ARUP, under subcontract with Gregg Drilling & Testing, Inc. (Gregg). Randy Dockery served as the point of contact for Gregg and Martin Walker served as the point of contact for ARUP.

This report describes the field measurements, data analysis, and results of this work.

SCOPE OF WORK

This report presents the results of boring geophysical measurements collected between September 4, 2013 and October 4, 2013, in three uncased borings, as detailed below. The purpose of these studies was to supplement stratigraphic information obtained during ARUP's soil sampling program and to acquire shear wave velocities and compressional wave velocities as a function of depth.

BORING	DATES LOGGED	ELEVATION (1) (NAVD88, FEET)	COORDINATES (DEGREES) (1)	
			LATITUDE	LONGITUDE
S0028R	9/4/2013	263	36.518282°	-119.723833°
S0067R	9/9/2013	NA	36.05088°	-119.52260°
S0072R	10/4/2013	NA	35.90814°	-119.41770°

(1) Coordinates approximated from Google Earth imagery or handheld GPS, WGS84 datum

Table 1. Boring locations and logging dates

The OYO Suspension PS Logging System (Suspension System) was used to obtain in-situ horizontal shear (S_H) and compressional (P) wave velocity measurements at 1.6 foot intervals. Measurements followed **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.5. The acquired data was analyzed and a profile of velocity versus depth was produced for both compressional and horizontally polarized shear waves.

A detailed reference for the suspension PS velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

INSTRUMENTATION

Suspension Velocity Instrumentation

Suspension velocity measurements were performed using the suspension PS logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. This system directly determines the average velocity of a 3.3-foot high segment of the soil column surrounding the boring of interest by measuring the elapsed time between arrivals of a wave propagating upward through the soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the boring producing relatively constant amplitude signals at all depths.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source (S_H) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is approximately 25 feet, with the center point of the receiver pair 12.5 feet above the bottom end of the probe.

The probe receives control signals from, and sends the digitized receiver signals to, instrumentation on the surface via an armored 4- or 7-conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a sheave of known circumference fitted with a digital rotary encoder.

The entire probe is suspended in the boring by the cable, therefore, source motion is not coupled directly to the boring walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the boring and surrounding the source. This pressure wave is converted to P and S_H-waves in the surrounding soil and rock as it passes through the casing and grout annulus and impinges upon the wall of the boring. These waves propagate

through the soil and rock surrounding the boring, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and S_H-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded S_H -wave signals.
2. At each depth, S_H-wave signals are recorded with the source actuated in opposite directions, producing S_H-wave signals of opposite polarity, providing a characteristic S_H-wave signature distinct from the P-wave signal.
3. The 6.3 foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower S_H-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and S_H-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received S_H-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe (feet versus inches scale), preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and S_H-wave arrivals; reversal of the source changes the polarity of the S_H-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation is recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing. Up to 8 sampling sequences can be summed to improve the signal to noise ratio of the signals.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and summing number to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed every twelve months using a NIST traceable frequency source and counter.

MEASUREMENT PROCEDURES

Suspension Velocity Measurement Procedures

Borings S0028R, S0067R and S0072R were logged as uncased boreholes filled with drilling fluid. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.5. Prior to each logging run, the probe was positioned with the top of the probe at the top of the surface casing and the electronic depth counter was set to the distance between the mid-point of the receiver and the top of the probe, minus the height of any casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the borings, stopping at 1.6 foot intervals to collect data, as summarized in Table 2.

At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed, and the gains were adjusted as required. The data from each depth were viewed on the computer display, checked, and recorded on disk before moving to the next depth.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the borings.

DATA ANALYSIS

Suspension Velocity Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 1.0 meter segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into a Microsoft Excel® template (version 2003 SP2) to complete the velocity calculations based upon the arrival time picks made in PSLOG. The Microsoft Excel® analysis files are included in the boring specific directories on the data disk (CD-R) that accompanies this report.

The P-wave velocity over the 6.3-foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in Microsoft Excel®, for quality assurance of the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 4.8 feet to correspond to the mid-point of the 6.3-foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting the calculated and experimentally verified delay from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, the recorded digital waveforms were analyzed to locate clear S_H-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the S_H-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital Fast Fourier Transform – Inverse Fast Fourier Transform (FFT – IFFT) lowpass filtering was used to remove the higher frequency P-wave signal from the S_H-wave signal. Different filter cutoffs were used to separate P- and S_H-waves

at different depths, ranging from 600 Hz in the slowest zones to 2000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the S_H-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source or by boring inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, S_H-wave velocity calculated from the travel time over the 6.3-foot interval from source to receiver 1 was calculated and plotted for verification of the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 4.8 feet to correspond to the mid-point of the 6.3-foot S-R1 interval. Travel times were obtained by picking the first break of the S_H-wave signal at the near receiver and subtracting the calculated and experimentally verified delay from the beginning of the record at the source trigger pulse to source impact.

These data and analysis were reviewed by Robert Steller as a component of **GEO***Vision*'s in-house data validation program.

Figure 2 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 2, the time difference over the 3.3 foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an S_H-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the S_H-waveform records to verify the data obtained from the first arrival of the S_H-wave pulse. Figure 3 displays the same record before filtering of the S_H-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter,

illustrating the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency S_H-wave by residual P-wave signal.

RESULTS

Suspension Velocity Results

Suspension R1-R2 P- and S_H-wave velocities for borings S0028R, S0067R and S0072R are plotted in Figures 4 through 6, respectively. The suspension velocity data presented in these figures are presented in Tables 3 through 5, respectively. The Microsoft Excel® analysis files are included in the data sub-directories on the disk (CD-R) that accompanies this report.

P- and S_H-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Figures A-1 through A-3 to aid in visual comparison. It should be noted that R1-R2 data are an average velocity over a 3.3-foot segment of the soil column; S-R1 data are an average over 6.3 feet, creating a significant smoothing relative to the R1-R2 plots. S-R1 data are presented in Tables A-1 through A-3 and are included in the Microsoft Excel® analysis files on the disk (CD-R) that accompanies this report. The Microsoft Excel® analysis files include Poisson's Ratio calculations, tabulated data and plots. The data presented in this report is marked as rev 1 or above, with rev 0 being the unprocessed data, as collected in the field.

SUMMARY

Discussion of Suspension Velocity Results

Suspension PS velocity data are ideally collected in an uncased fluid filled boring, drilled with rotary mud (rotary wash) methods. These borings were well suited for the collection of suspension PS velocity data.

Suspension PS velocity data quality is judged based upon 5 criteria:

1. Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.
2. Consistent relationship between P-wave and S_H -wave (excluding transition to saturated soils)
3. Consistency between data from adjacent depth intervals.
4. Clarity of P-wave and S_H-wave onset, as well as damping of later oscillations.
5. Consistency of profile between adjacent borings, if available.

Boring S0028R shows excellent correlation between R1 – R2 and S – R1 data, as well as good correlation between P-wave and S_H-wave velocities, other than at transitions into saturated soils, as discussed below. Adjacent depth give similar velocities and waveforms, and the onset of P- and S_H-wave signals are clear, and well damped. There are a number of P- and S_H-wave velocity spikes in this boring that are indicative of thin cemented layers. They are centered at 25, 48, 84, 97, 114 and 135 feet. There is an increase in P-wave velocity not present in the S_H-wave velocity data to over 5000 feet/second at about 104 feet, indicating saturated soils below this depth. There is also an increase in P-wave velocity not present in the S_H-wave velocity data between 65 and 70 feet indicating a possible perched water table at this depth.

Boring S0067R shows excellent correlation between R1 – R2 and S – R1 data, as well as good correlation between P-wave and S_H-wave velocities, other than at transitions into saturated soils, as discussed below. Adjacent depth give similar velocities and waveforms, and the onset of P- and S_H-wave signals are clear, and well damped. There is an increase in P-wave velocity not present in the S_H-wave velocity data to over 5000 feet/second at about 52 feet, indicating saturated soils below this depth. There is also an increase in P-wave velocity not present in the S_H-wave velocity data between 32 and 45 feet indicating a possible perched water table in this depth range.

Boring S0072R shows excellent correlation between R1 – R2 and S – R1 data, as well as good correlation between P-wave and S_H-wave velocities, other than at transitions into saturated soils, as discussed below. Adjacent depth give similar velocities and waveforms, and the onset of P- and S_H-wave signals are clear, and well damped. There is an increase in P-wave velocity not present in the S_H-wave velocity data to over 5000 feet/second at about 20 feet, indicating saturated soils below this depth.

Quality Assurance

These boring geophysical measurements were performed using industry-standard or better methods for measurements and analyses. All work was performed under **GEO***Vision* quality assurance procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

Suspension Velocity Data Reliability

P- and S_H-wave velocity measurement using the Suspension Method gives average velocities over a 3.3-foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Depth indications are very reliable with estimated precision of +/- 0.2 feet. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

Table 2. Logging dates and depth ranges

BORING NUMBER	TOOL AND RUN NUMBER	DEPTH RANGE (FEET)	CASED OR UNCASED	SAMPLE INTERVAL (FEET)	DATE LOGGED
S0028R	SUSPENSION 01	9.84 – 152.56	UNCASED	1.6	9/4/2013
S0067R	SUSPENSION 01	3.28 – 152.56	UNCASED	1.6	9/9/2013
S0072R	SUSPENSION 01	4.92 – 152.56	UNCASED	1.6	10/4/2013

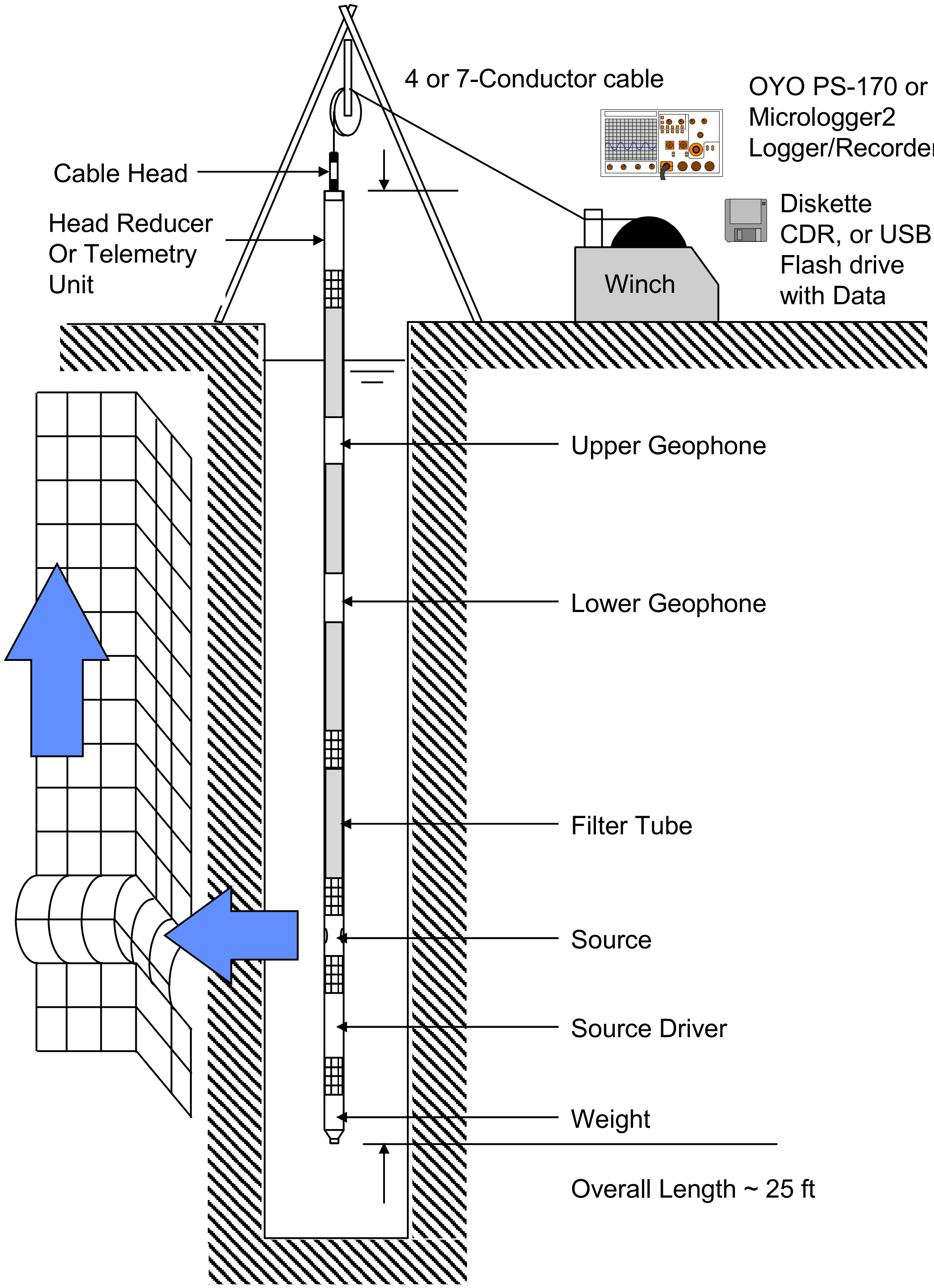

Figure 1: Concept illustration of P-S logging system

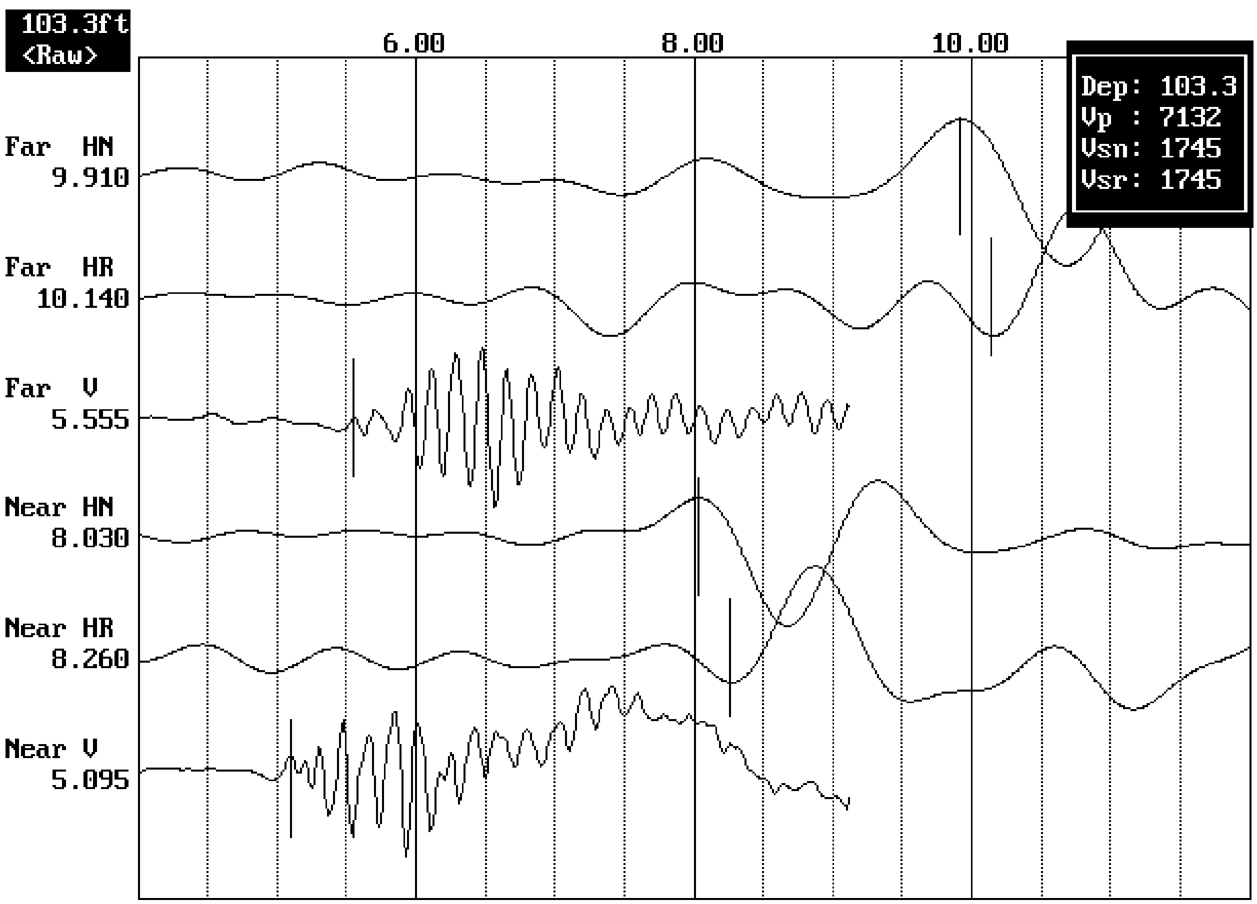

Figure 2: Example of filtered (1400 Hz lowpass) record

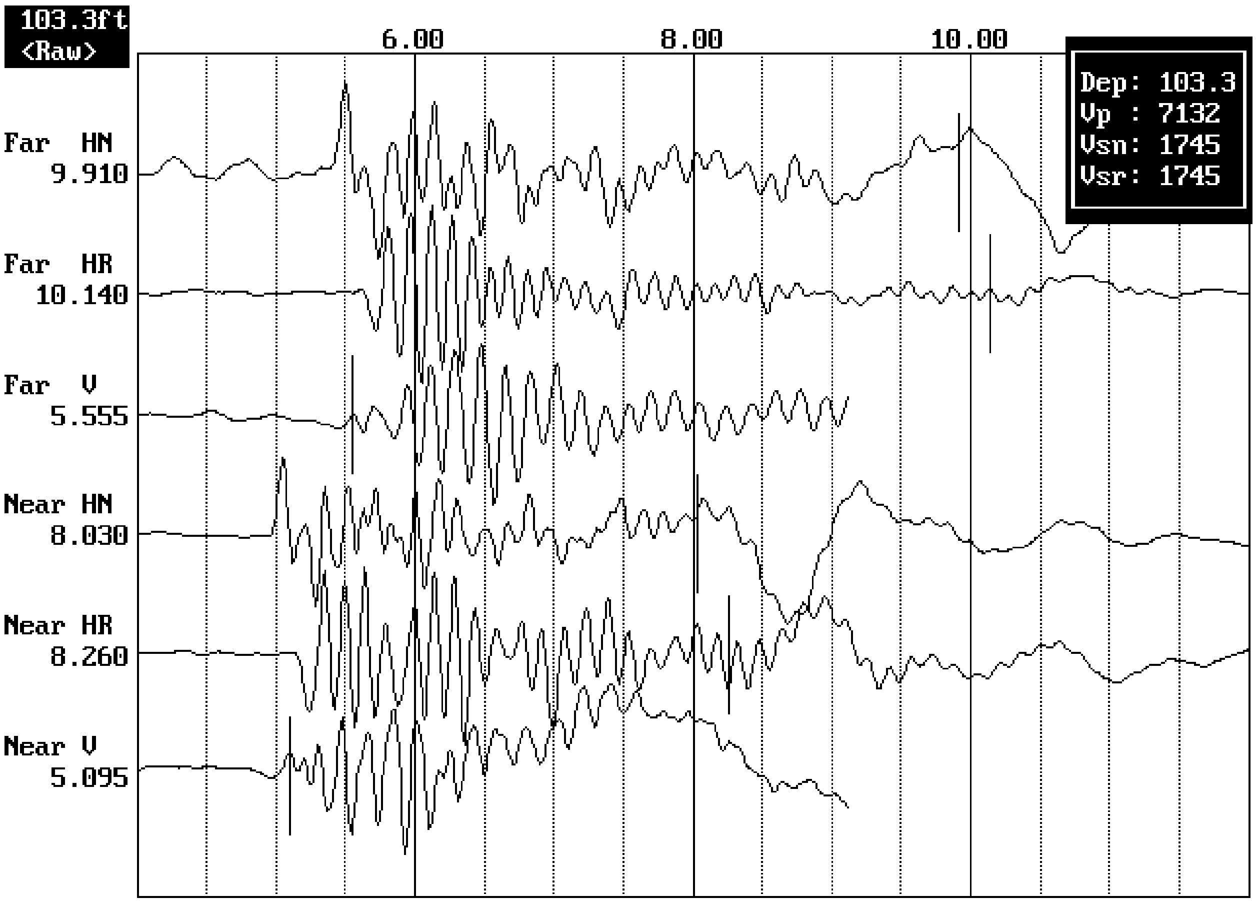

Figure 3. Example of unfiltered record

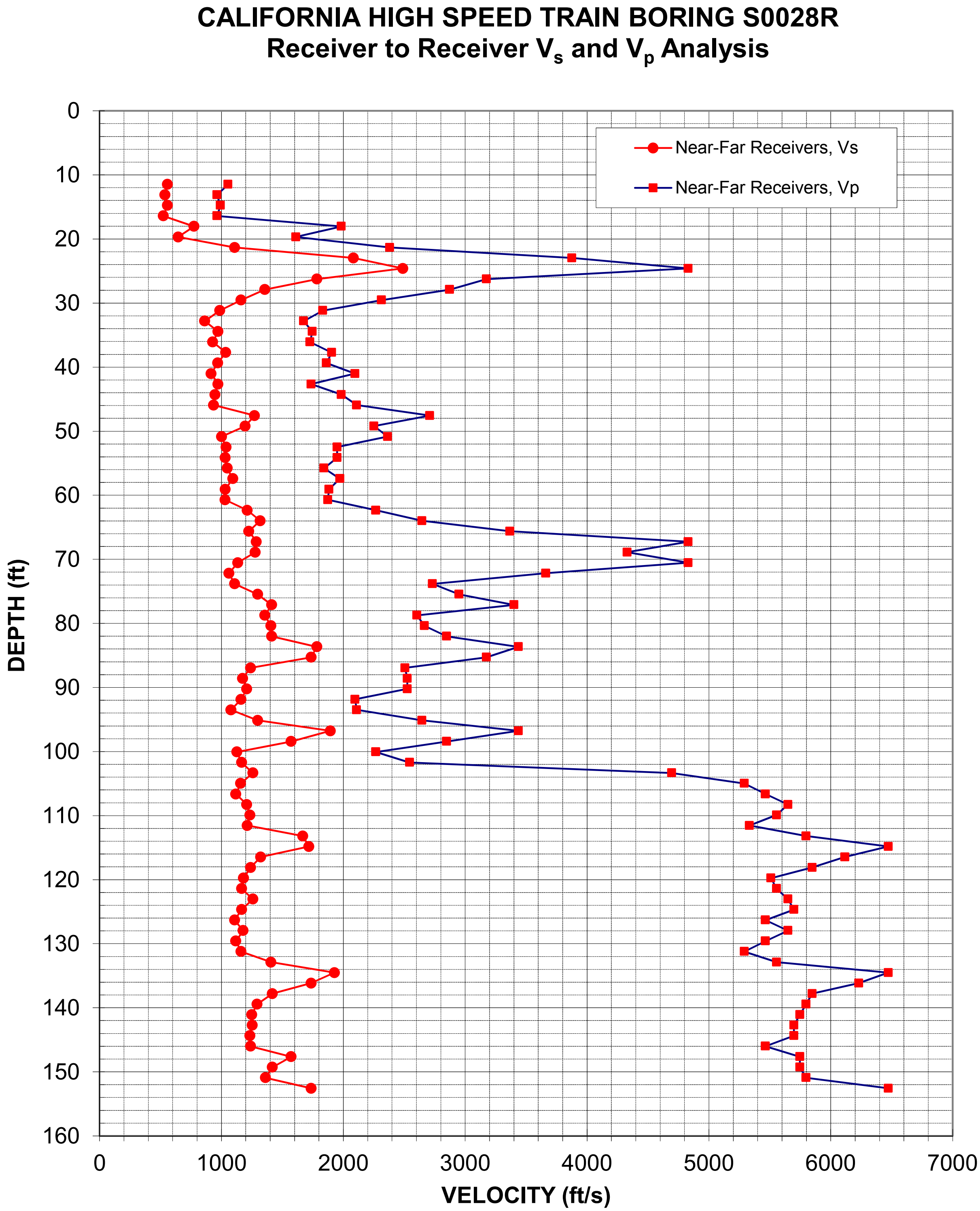

Figure 4: Boring S0028R, Suspension R1-R2 P- and S_H-wave velocities

Table 3. Boring S0028R, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole S0028R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
9.8	-	-	-	3.0	-	-	-
11.5	560	1050	0.31	3.5	170	320	0.31
13.1	540	960	0.28	4.0	160	290	0.28
14.8	560	990	0.27	4.5	170	300	0.27
16.4	520	960	0.29	5.0	160	290	0.29
18.0	780	1980	0.41	5.5	240	600	0.41
19.7	640	1610	0.40	6.0	200	490	0.40
21.3	1110	2380	0.36	6.5	340	730	0.36
23.0	2080	3880	0.30	7.0	640	1180	0.30
24.6	2490	4830	0.32	7.5	760	1470	0.32
26.3	1780	3170	0.27	8.0	540	970	0.27
27.9	1360	2870	0.36	8.5	410	880	0.36
29.5	1160	2310	0.33	9.0	350	710	0.33
31.2	990	1830	0.30	9.5	300	560	0.30
32.8	860	1680	0.32	10.0	260	510	0.32
34.5	970	1750	0.28	10.5	300	530	0.28
36.1	930	1730	0.30	11.0	280	530	0.30
37.7	1040	1900	0.29	11.5	320	580	0.29
39.4	970	1860	0.31	12.0	300	570	0.31
41.0	920	2100	0.38	12.5	280	640	0.38
42.7	970	1740	0.27	13.0	300	530	0.27
44.3	950	1980	0.35	13.5	290	600	0.35
45.9	940	2110	0.38	14.0	290	640	0.38
47.6	1270	2710	0.36	14.5	390	830	0.36
49.2	1190	2250	0.30	15.0	360	690	0.30
50.9	1000	2360	0.39	15.5	310	720	0.39
52.5	1040	1950	0.30	16.0	320	590	0.30
54.1	1030	1950	0.31	16.5	310	590	0.31
55.8	1050	1840	0.26	17.0	320	560	0.26
57.4	1090	1970	0.28	17.5	330	600	0.28
59.1	1030	1880	0.29	18.0	310	570	0.29
60.7	1030	1870	0.28	18.5	310	570	0.28
62.3	1210	2270	0.30	19.0	370	690	0.30
64.0	1320	2650	0.34	19.5	400	810	0.34
65.6	1230	3370	0.42	20.0	370	1030	0.42
67.3	1290	4830	0.46	20.5	390	1470	0.46
68.9	1280	4330	0.45	21.0	390	1320	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole S0028R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
70.5	1130	4830	0.47	21.5	350	1470	0.47
72.2	1060	3660	0.45	22.0	320	1120	0.45
73.8	1110	2730	0.40	22.5	340	830	0.40
75.5	1300	2950	0.38	23.0	400	900	0.38
77.1	1410	3400	0.40	23.5	430	1040	0.40
78.7	1360	2600	0.31	24.0	410	790	0.31
80.4	1410	2670	0.31	24.5	430	810	0.31
82.0	1410	2850	0.34	25.0	430	870	0.34
83.7	1780	3440	0.32	25.5	540	1050	0.32
85.3	1740	3170	0.29	26.0	530	970	0.29
86.9	1240	2510	0.34	26.5	380	760	0.34
88.6	1170	2530	0.36	27.0	360	770	0.36
90.2	1210	2530	0.35	27.5	370	770	0.35
91.9	1160	2100	0.28	28.0	350	640	0.28
93.5	1080	2110	0.32	28.5	330	640	0.32
95.1	1300	2650	0.34	29.0	400	810	0.34
96.8	1890	3440	0.28	29.5	580	1050	0.28
98.4	1570	2850	0.28	30.0	480	870	0.28
100.1	1130	2270	0.34	30.5	340	690	0.34
101.7	1170	2540	0.37	31.0	360	780	0.37
103.4	1260	4690	0.46	31.5	380	1430	0.46
105.0	1160	5290	0.47	32.0	350	1610	0.47
106.6	1120	5460	0.48	32.5	340	1670	0.48
108.3	1210	5650	0.48	33.0	370	1720	0.48
109.9	1230	5560	0.47	33.5	380	1690	0.47
111.6	1210	5330	0.47	34.0	370	1630	0.47
113.2	1670	5800	0.45	34.5	510	1770	0.45
114.8	1720	6470	0.46	35.0	520	1970	0.46
116.5	1320	6120	0.48	35.5	400	1860	0.48
118.1	1240	5850	0.48	36.0	380	1780	0.48
119.8	1180	5510	0.48	36.5	360	1680	0.48
121.4	1170	5560	0.48	37.0	360	1690	0.48
123.0	1260	5650	0.47	37.5	380	1720	0.47
124.7	1170	5700	0.48	38.0	360	1740	0.48
126.3	1110	5460	0.48	38.5	340	1670	0.48
128.0	1180	5650	0.48	39.0	360	1720	0.48
129.6	1120	5460	0.48	39.5	340	1670	0.48
131.2	1160	5290	0.47	40.0	350	1610	0.47
132.9	1410	5560	0.47	40.5	430	1690	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole S0028R

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
134.5	1930	6470	0.45
136.2	1740	6230	0.46
137.8	1420	5850	0.47
139.4	1290	5800	0.47
141.1	1250	5750	0.48
142.7	1250	5700	0.47
144.4	1230	5700	0.48
146.0	1240	5460	0.47
147.6	1570	5750	0.46
149.3	1420	5750	0.47
150.9	1360	5800	0.47
152.6	1740	6470	0.46

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
41.0	590	1970	0.45
41.5	530	1900	0.46
42.0	430	1780	0.47
42.5	390	1770	0.47
43.0	380	1750	0.48
43.5	380	1740	0.47
44.0	380	1740	0.48
44.5	380	1670	0.47
45.0	480	1750	0.46
45.5	430	1750	0.47
46.0	410	1770	0.47
46.5	530	1970	0.46

Notes: "-" means no data available at that particular interval of depth.

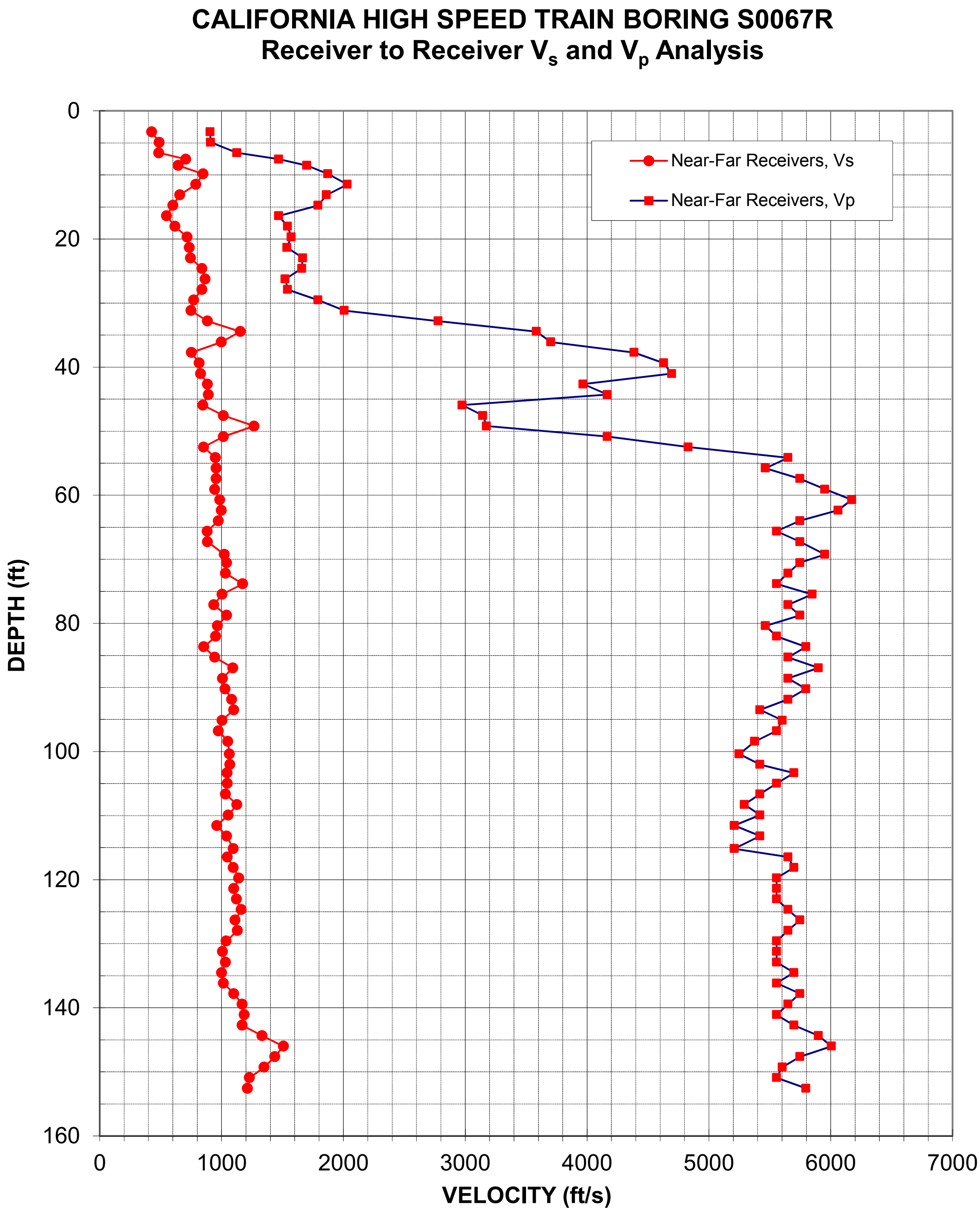

Figure 5: Boring S0067R, Suspension R1-R2 P- and S_H-wave velocities

Table 4. Boring S0067R, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole S0067R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
3.3	430	910	0.36	1.0	130	280	0.36
4.9	490	910	0.30	1.5	150	280	0.30
6.6	480	1130	0.39	2.0	150	340	0.39
7.6	710	1470	0.35	2.3	220	450	0.35
8.5	640	1700	0.42	2.6	200	520	0.42
9.8	850	1870	0.37	3.0	260	570	0.37
11.5	790	2030	0.41	3.5	240	620	0.41
13.1	660	1860	0.43	4.0	200	570	0.43
14.8	600	1790	0.44	4.5	180	550	0.44
16.4	550	1470	0.42	5.0	170	450	0.42
18.0	620	1540	0.40	5.5	190	470	0.40
19.7	720	1570	0.37	6.0	220	480	0.37
21.3	740	1540	0.35	6.5	220	470	0.35
23.0	740	1670	0.38	7.0	230	510	0.38
24.6	840	1660	0.33	7.5	260	510	0.33
26.3	870	1520	0.26	8.0	260	460	0.26
27.9	840	1540	0.29	8.5	260	470	0.29
29.5	770	1790	0.39	9.0	230	550	0.39
31.2	750	2010	0.42	9.5	230	610	0.42
32.8	880	2780	0.44	10.0	270	850	0.44
34.5	1150	3580	0.44	10.5	350	1090	0.44
36.1	1000	3700	0.46	11.0	300	1130	0.46
37.7	750	4390	0.48	11.5	230	1340	0.48
39.4	820	4630	0.48	12.0	250	1410	0.48
41.0	830	4690	0.48	12.5	250	1430	0.48
42.7	880	3970	0.47	13.0	270	1210	0.47
44.3	890	4170	0.48	13.5	270	1270	0.48
45.9	850	2980	0.46	14.0	260	910	0.46
47.6	1020	3140	0.44	14.5	310	960	0.44
49.2	1270	3170	0.41	15.0	390	970	0.41
50.9	1020	4170	0.47	15.5	310	1270	0.47
52.5	850	4830	0.48	16.0	260	1470	0.48
54.1	950	5650	0.49	16.5	290	1720	0.49
55.8	960	5460	0.48	17.0	290	1670	0.48
57.4	960	5750	0.49	17.5	290	1750	0.49
59.1	940	5950	0.49	18.0	290	1810	0.49
60.7	990	6170	0.49	18.5	300	1880	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole S0067R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
62.3	1000	6060	0.49	19.0	300	1850	0.49
64.0	970	5750	0.49	19.5	300	1750	0.49
65.6	880	5560	0.49	20.0	270	1690	0.49
67.3	880	5750	0.49	20.5	270	1750	0.49
69.2	1020	5950	0.48	21.1	310	1810	0.48
70.5	1040	5750	0.48	21.5	320	1750	0.48
72.2	1030	5650	0.48	22.0	310	1720	0.48
73.8	1170	5560	0.48	22.5	360	1690	0.48
75.5	1000	5850	0.48	23.0	310	1780	0.48
77.1	940	5650	0.49	23.5	290	1720	0.49
78.7	1040	5750	0.48	24.0	320	1750	0.48
80.4	970	5460	0.48	24.5	290	1670	0.48
82.0	950	5560	0.48	25.0	290	1690	0.48
83.7	850	5800	0.49	25.5	260	1770	0.49
85.3	940	5650	0.49	26.0	290	1720	0.49
86.9	1090	5900	0.48	26.5	330	1800	0.48
88.6	1010	5650	0.48	27.0	310	1720	0.48
90.2	1030	5800	0.48	27.5	310	1770	0.48
91.9	1080	5650	0.48	28.0	330	1720	0.48
93.5	1100	5420	0.48	28.5	340	1650	0.48
95.1	1000	5600	0.48	29.0	310	1710	0.48
96.8	970	5560	0.48	29.5	300	1690	0.48
98.4	1050	5380	0.48	30.0	320	1640	0.48
100.4	1060	5250	0.48	30.6	320	1600	0.48
102.0	1070	5420	0.48	31.1	330	1650	0.48
103.4	1040	5700	0.48	31.5	320	1740	0.48
105.0	1050	5560	0.48	32.0	320	1690	0.48
106.6	1030	5420	0.48	32.5	310	1650	0.48
108.3	1130	5290	0.48	33.0	340	1610	0.48
109.9	1050	5420	0.48	33.5	320	1650	0.48
111.6	960	5210	0.48	34.0	290	1590	0.48
113.2	1040	5420	0.48	34.5	320	1650	0.48
115.2	1100	5210	0.48	35.1	330	1590	0.48
116.5	1050	5650	0.48	35.5	320	1720	0.48
118.1	1100	5700	0.48	36.0	330	1740	0.48
119.8	1140	5560	0.48	36.5	350	1690	0.48
121.4	1100	5560	0.48	37.0	340	1690	0.48
123.0	1120	5560	0.48	37.5	340	1690	0.48
124.7	1160	5650	0.48	38.0	350	1720	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole S0067R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
126.3	1110	5750	0.48	38.5	340	1750	0.48
128.0	1130	5650	0.48	39.0	340	1720	0.48
129.6	1040	5560	0.48	39.5	320	1690	0.48
131.2	1010	5560	0.48	40.0	310	1690	0.48
132.9	1030	5560	0.48	40.5	310	1690	0.48
134.5	1000	5700	0.48	41.0	310	1740	0.48
136.2	1020	5560	0.48	41.5	310	1690	0.48
137.8	1100	5750	0.48	42.0	340	1750	0.48
139.4	1170	5650	0.48	42.5	360	1720	0.48
141.1	1190	5560	0.48	43.0	360	1690	0.48
142.7	1170	5700	0.48	43.5	360	1740	0.48
144.4	1330	5900	0.47	44.0	410	1800	0.47
146.0	1510	6010	0.47	44.5	460	1830	0.47
147.6	1440	5750	0.47	45.0	440	1750	0.47
149.3	1350	5600	0.47	45.5	410	1710	0.47
150.9	1230	5560	0.47	46.0	370	1690	0.47
152.6	1210	5800	0.48	46.5	370	1770	0.48

CALIFORNIA HIGH SPEED TRAIN BORING S0072R
Receiver to Receiver V_s and V_p Analysis

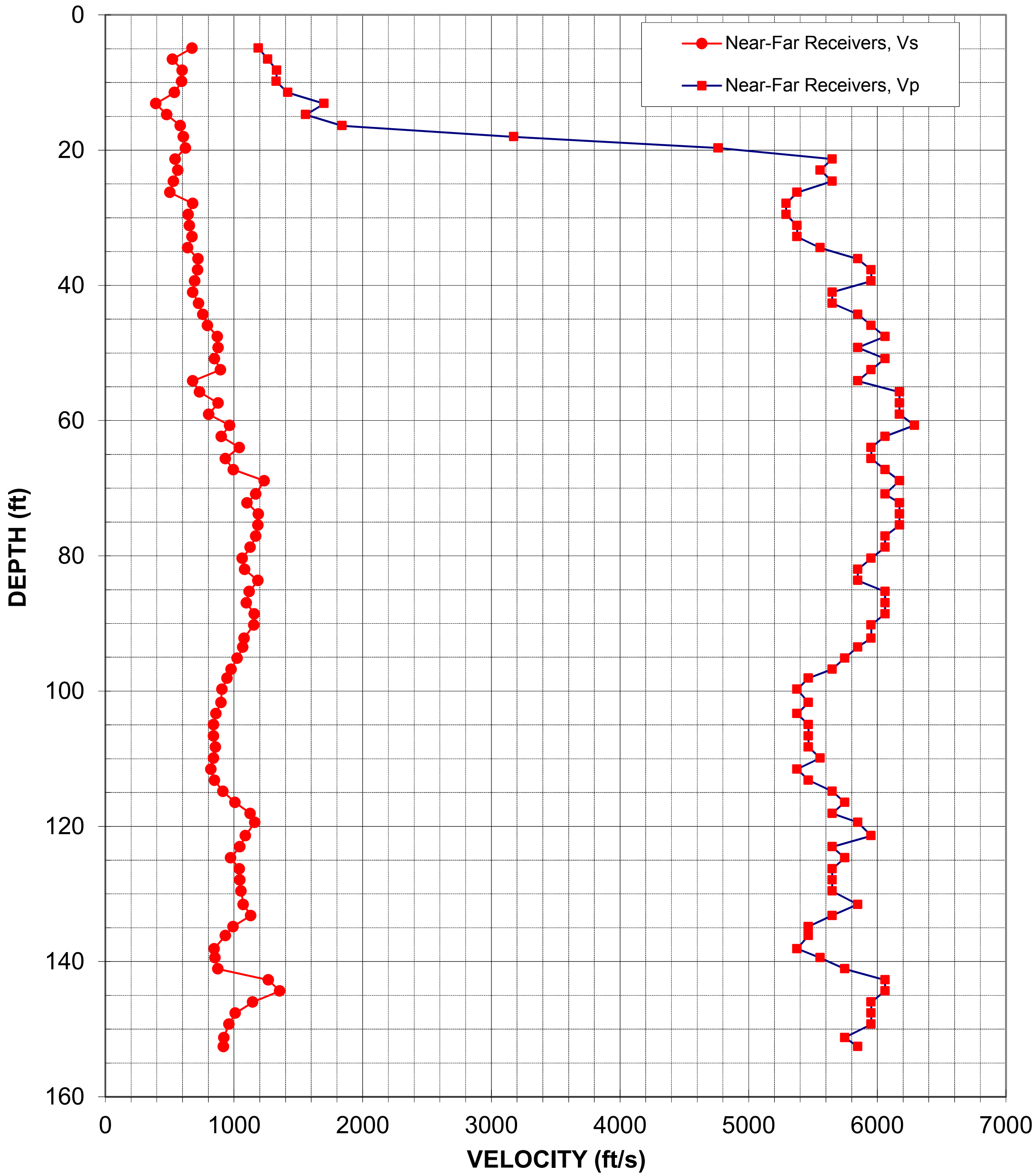

Figure 6: Boring S0072R, Suspension R1-R2 P- and S_H-wave velocities

Table 5. Boring S0072R, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole S0072R

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
4.9	670	1190	0.26	1.5	210	360	0.26
6.6	520	1260	0.40	2.0	160	380	0.40
8.2	600	1330	0.37	2.5	180	410	0.37
9.8	590	1330	0.38	3.0	180	400	0.38
11.5	540	1420	0.42	3.5	160	430	0.42
13.1	390	1700	0.47	4.0	120	520	0.47
14.8	480	1560	0.45	4.5	150	470	0.45
16.4	580	1840	0.44	5.0	180	560	0.44
18.0	610	3170	0.48	5.5	180	970	0.48
19.7	620	4760	0.49	6.0	190	1450	0.49
21.3	540	5650	0.50	6.5	170	1720	0.50
23.0	560	5560	0.49	7.0	170	1690	0.49
24.6	530	5650	0.50	7.5	160	1720	0.50
26.3	500	5380	0.50	8.0	150	1640	0.50
27.9	680	5290	0.49	8.5	210	1610	0.49
29.5	640	5290	0.49	9.0	200	1610	0.49
31.2	650	5380	0.49	9.5	200	1640	0.49
32.8	670	5380	0.49	10.0	210	1640	0.49
34.5	640	5560	0.49	10.5	200	1690	0.49
36.1	720	5850	0.49	11.0	220	1780	0.49
37.7	720	5950	0.49	11.5	220	1810	0.49
39.4	690	5950	0.49	12.0	210	1810	0.49
41.0	680	5650	0.49	12.5	210	1720	0.49
42.7	720	5650	0.49	13.0	220	1720	0.49
44.3	760	5850	0.49	13.5	230	1780	0.49
45.9	790	5950	0.49	14.0	240	1810	0.49
47.6	870	6060	0.49	14.5	270	1850	0.49
49.2	880	5850	0.49	15.0	270	1780	0.49
50.9	850	6060	0.49	15.5	260	1850	0.49
52.5	890	5950	0.49	16.0	270	1810	0.49
54.1	680	5850	0.49	16.5	210	1780	0.49
55.8	730	6170	0.49	17.0	220	1880	0.49
57.4	880	6170	0.49	17.5	270	1880	0.49
59.1	800	6170	0.49	18.0	240	1880	0.49
60.7	970	6290	0.49	18.5	290	1920	0.49
62.3	900	6060	0.49	19.0	270	1850	0.49
64.0	1040	5950	0.48	19.5	320	1810	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole S0072R

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
65.6	930	5950	0.49
67.3	1000	6060	0.49
68.9	1230	6170	0.48
70.9	1170	6060	0.48
72.2	1100	6170	0.48
73.8	1190	6170	0.48
75.5	1190	6170	0.48
77.1	1170	6060	0.48
78.7	1130	6060	0.48
80.4	1060	5950	0.48
82.0	1080	5850	0.48
83.7	1190	5850	0.48
85.3	1120	6060	0.48
86.9	1100	6060	0.48
88.6	1160	6060	0.48
90.2	1150	5950	0.48
92.2	1080	5950	0.48
93.5	1070	5850	0.48
95.1	1030	5750	0.48
96.8	980	5650	0.48
98.1	950	5460	0.48
99.7	910	5380	0.49
101.7	900	5460	0.49
103.4	860	5380	0.49
105.0	840	5460	0.49
106.6	840	5460	0.49
108.3	860	5460	0.49
109.9	840	5560	0.49
111.6	820	5380	0.49
113.2	850	5460	0.49
114.8	910	5650	0.49
116.5	1010	5750	0.48
118.1	1130	5650	0.48
119.4	1160	5850	0.48
121.4	1090	5950	0.48
123.0	1040	5650	0.48
124.7	970	5750	0.49
126.3	1040	5650	0.48
128.0	1040	5650	0.48

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
20.0	280	1810	0.49
20.5	300	1850	0.49
21.0	380	1880	0.48
21.6	360	1850	0.48
22.0	340	1880	0.48
22.5	360	1880	0.48
23.0	360	1880	0.48
23.5	360	1850	0.48
24.0	340	1850	0.48
24.5	320	1810	0.48
25.0	330	1780	0.48
25.5	360	1780	0.48
26.0	340	1850	0.48
26.5	330	1850	0.48
27.0	350	1850	0.48
27.5	350	1810	0.48
28.1	330	1810	0.48
28.5	330	1780	0.48
29.0	310	1750	0.48
29.5	300	1720	0.48
29.9	290	1670	0.48
30.4	280	1640	0.49
31.0	270	1670	0.49
31.5	260	1640	0.49
32.0	260	1670	0.49
32.5	260	1670	0.49
33.0	260	1670	0.49
33.5	260	1690	0.49
34.0	250	1640	0.49
34.5	260	1670	0.49
35.0	280	1720	0.49
35.5	310	1750	0.48
36.0	340	1720	0.48
36.4	350	1780	0.48
37.0	330	1810	0.48
37.5	320	1720	0.48
38.0	300	1750	0.49
38.5	320	1720	0.48
39.0	320	1720	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole S0072R

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
129.6	1050	5650	0.48
131.6	1070	5850	0.48
133.2	1130	5650	0.48
134.8	990	5460	0.48
136.2	930	5460	0.48
138.1	850	5380	0.49
139.4	850	5560	0.49
141.1	870	5750	0.49
142.7	1270	6060	0.48
144.4	1360	6060	0.47
146.0	1150	5950	0.48
147.6	1010	5950	0.49
149.3	960	5950	0.49
151.3	920	5750	0.49
152.6	920	5850	0.49

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
39.5	320	1720	0.48
40.1	330	1780	0.48
40.6	340	1720	0.48
41.1	300	1670	0.48
41.5	280	1670	0.48
42.1	260	1640	0.49
42.5	260	1690	0.49
43.0	270	1750	0.49
43.5	390	1850	0.48
44.0	410	1850	0.47
44.5	350	1810	0.48
45.0	310	1810	0.49
45.5	290	1810	0.49
46.1	280	1750	0.49
46.5	280	1780	0.49

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

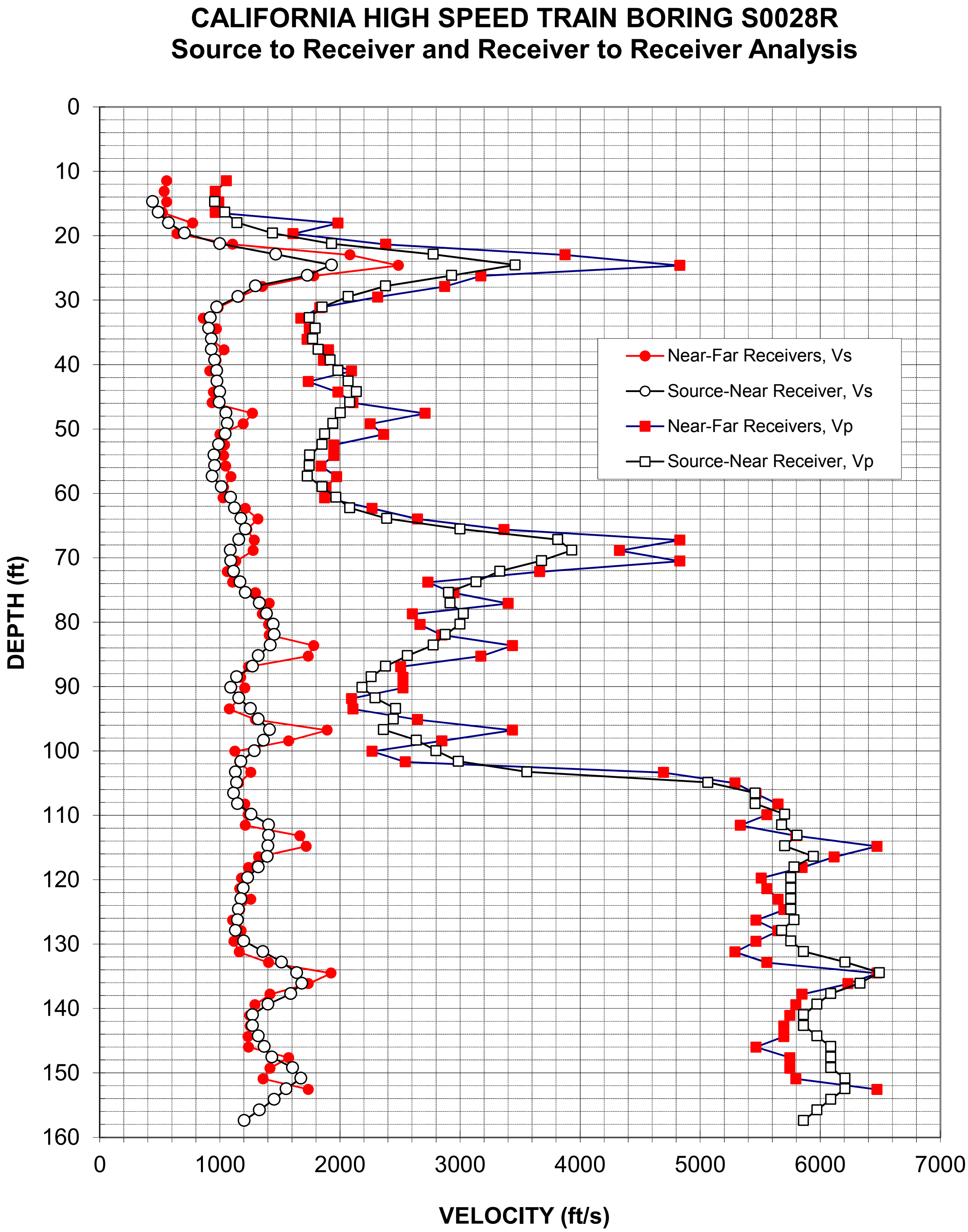

Figure A-1: Boring S0028R, Suspension S-R1 P- and S_H-wave velocities

Table A-1. Boring S0028R, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole S0028R

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
14.7	440	960	0.37	4.5	130	290	0.37
16.3	490	1040	0.36	5.0	150	320	0.36
18.0	570	1140	0.33	5.5	170	350	0.33
19.6	700	1440	0.34	6.0	210	440	0.34
21.2	1000	1930	0.32	6.5	300	590	0.32
22.9	1470	2780	0.31	7.0	450	850	0.31
24.5	1930	3460	0.27	7.5	590	1050	0.27
26.2	1730	2930	0.23	8.0	530	890	0.23
27.8	1300	2380	0.29	8.5	400	730	0.29
29.4	1150	2070	0.28	9.0	350	630	0.28
31.1	970	1850	0.31	9.5	300	560	0.31
32.7	920	1740	0.31	10.0	280	530	0.31
34.4	910	1790	0.33	10.5	280	550	0.33
36.0	930	1770	0.31	11.0	280	540	0.31
37.6	930	1820	0.32	11.5	280	550	0.32
39.3	960	1920	0.33	12.0	290	580	0.33
40.9	970	1980	0.34	12.5	300	600	0.34
42.6	980	2070	0.36	13.0	300	630	0.36
44.2	1000	2140	0.36	13.5	300	650	0.36
45.8	1000	2080	0.35	14.0	300	630	0.35
47.5	1050	2000	0.31	14.5	320	610	0.31
49.1	1060	1940	0.29	15.0	320	590	0.29
50.8	1040	1870	0.27	15.5	320	570	0.27
52.4	990	1850	0.30	16.0	300	560	0.30
54.0	950	1750	0.29	16.5	290	530	0.29
55.7	960	1740	0.29	17.0	290	530	0.29
57.3	940	1730	0.29	17.5	290	530	0.29
59.0	1010	1850	0.29	18.0	310	560	0.29
60.6	1090	1970	0.28	18.5	330	600	0.28
62.2	1120	2080	0.30	19.0	340	630	0.30
63.9	1180	2390	0.34	19.5	360	730	0.34
65.5	1210	3000	0.40	20.0	370	910	0.40
67.2	1160	3810	0.45	20.5	350	1160	0.45
68.8	1090	3930	0.46	21.0	330	1200	0.46
70.5	1090	3680	0.45	21.5	330	1120	0.45
72.1	1110	3330	0.44	22.0	340	1020	0.44
73.7	1170	3130	0.42	22.5	360	960	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0028R

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
75.4	1210	2900	0.39
77.0	1330	2920	0.37
78.7	1390	3030	0.37
80.3	1450	3000	0.35
81.9	1450	2880	0.33
83.6	1420	2780	0.32
85.2	1320	2560	0.32
86.9	1270	2380	0.30
88.5	1140	2260	0.33
90.1	1090	2180	0.33
91.8	1160	2290	0.33
93.4	1250	2460	0.33
95.1	1320	2440	0.29
96.7	1410	2360	0.22
98.3	1360	2640	0.32
100.0	1290	2800	0.37
101.6	1180	2990	0.41
103.3	1130	3560	0.44
104.9	1140	5060	0.47
106.5	1110	5460	0.48
108.2	1150	5460	0.48
109.8	1260	5700	0.47
111.5	1410	5680	0.47
113.1	1410	5810	0.47
114.7	1400	5700	0.47
116.4	1390	5940	0.47
118.0	1320	5780	0.47
119.7	1230	5750	0.48
121.3	1190	5750	0.48
122.9	1180	5750	0.48
124.6	1160	5750	0.48
126.2	1150	5780	0.48
127.9	1130	5680	0.48
129.5	1200	5750	0.48
131.1	1360	5860	0.47
132.8	1510	6210	0.47
134.4	1640	6490	0.47
136.1	1680	6330	0.46
137.7	1590	6090	0.46
139.3	1400	5970	0.47

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
23.0	370	890	0.39
23.5	410	890	0.37
24.0	420	920	0.37
24.5	440	910	0.35
25.0	440	880	0.33
25.5	430	850	0.32
26.0	400	780	0.32
26.5	390	730	0.30
27.0	350	690	0.33
27.5	330	670	0.33
28.0	350	700	0.33
28.5	380	750	0.33
29.0	400	740	0.29
29.5	430	720	0.22
30.0	420	800	0.32
30.5	390	850	0.37
31.0	360	910	0.41
31.5	340	1080	0.44
32.0	350	1540	0.47
32.5	340	1660	0.48
33.0	350	1660	0.48
33.5	380	1740	0.47
34.0	430	1730	0.47
34.5	430	1770	0.47
35.0	430	1740	0.47
35.5	420	1810	0.47
36.0	400	1760	0.47
36.5	380	1750	0.48
37.0	360	1750	0.48
37.5	360	1750	0.48
38.0	350	1750	0.48
38.5	350	1760	0.48
39.0	340	1730	0.48
39.5	370	1750	0.48
40.0	410	1790	0.47
40.5	460	1890	0.47
41.0	500	1980	0.47
41.5	510	1930	0.46
42.0	480	1860	0.46
42.5	430	1820	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0028R

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
141.0	1270	5860	0.48
142.6	1270	5860	0.48
144.3	1320	5970	0.47
145.9	1370	6090	0.47
147.6	1430	6090	0.47
149.2	1610	6090	0.46
150.8	1670	6210	0.46
152.5	1550	6210	0.47
154.1	1450	6090	0.47
155.8	1330	5970	0.47
157.4	1200	5860	0.48

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
43.0	390	1790	0.48
43.5	390	1790	0.48
44.0	400	1820	0.47
44.5	420	1860	0.47
45.0	440	1860	0.47
45.5	490	1860	0.46
46.0	510	1890	0.46
46.5	470	1890	0.47
47.0	440	1860	0.47
47.5	410	1820	0.47
48.0	370	1790	0.48

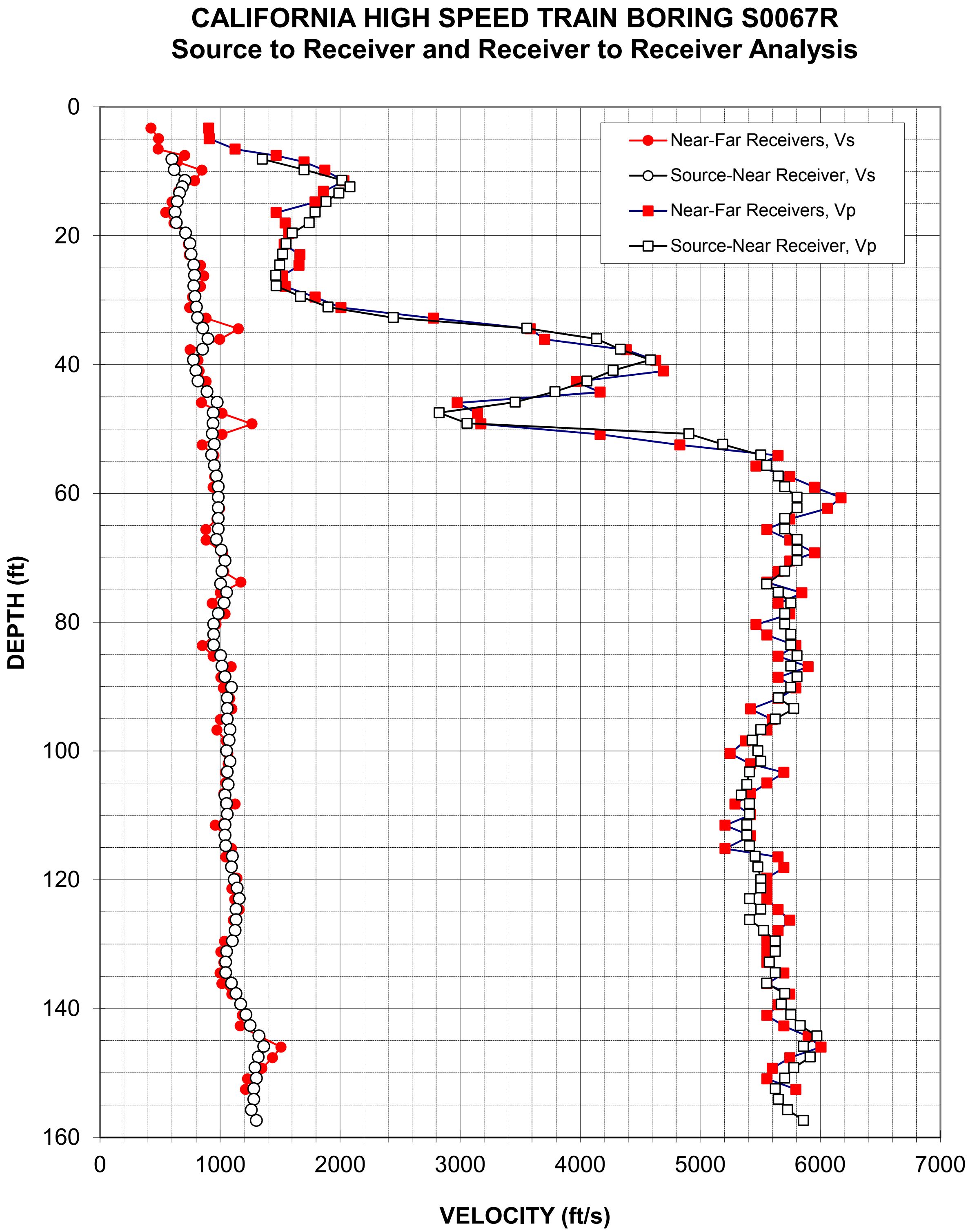

Figure A-2: Boring S0067R, Suspension S-R1 P- and S_H-wave velocities

Table A-2. Boring S0067R, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole S0067R

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
8.1	600	1350	0.38	2.5	180	410	0.38
9.8	620	1700	0.42	3.0	190	520	0.42
11.4	710	2020	0.43	3.5	220	610	0.43
12.4	690	2080	0.44	3.8	210	630	0.44
13.4	660	1990	0.44	4.1	200	610	0.44
14.7	640	1880	0.43	4.5	200	570	0.43
16.3	630	1790	0.43	5.0	190	550	0.43
18.0	640	1740	0.42	5.5	190	530	0.42
19.6	710	1600	0.38	6.0	220	490	0.38
21.2	750	1550	0.35	6.5	230	470	0.35
22.9	760	1520	0.33	7.0	230	460	0.33
24.5	780	1500	0.31	7.5	240	460	0.31
26.2	790	1470	0.30	8.0	240	450	0.30
27.8	780	1470	0.30	8.5	240	450	0.30
29.4	790	1670	0.35	9.0	240	510	0.35
31.1	800	1900	0.39	9.5	240	580	0.39
32.7	810	2440	0.44	10.0	250	740	0.44
34.4	860	3560	0.47	10.5	260	1080	0.47
36.0	900	4140	0.48	11.0	270	1260	0.48
37.6	860	4340	0.48	11.5	260	1320	0.48
39.3	780	4590	0.49	12.0	240	1400	0.49
40.9	800	4280	0.48	12.5	240	1300	0.48
42.6	820	4060	0.48	13.0	250	1240	0.48
44.2	890	3790	0.47	13.5	270	1160	0.47
45.8	980	3460	0.46	14.0	300	1050	0.46
47.5	940	2830	0.44	14.5	290	860	0.44
49.1	940	3060	0.45	15.0	290	930	0.45
50.8	940	4910	0.48	15.5	290	1500	0.48
52.4	950	5190	0.48	16.0	290	1580	0.48
54.0	930	5500	0.49	16.5	280	1680	0.49
55.7	950	5550	0.48	17.0	290	1690	0.48
57.3	970	5650	0.48	17.5	300	1720	0.48
59.0	990	5700	0.48	18.0	300	1740	0.48
60.6	990	5810	0.49	18.5	300	1770	0.49
62.2	990	5810	0.49	19.0	300	1770	0.49
63.9	990	5700	0.48	19.5	300	1740	0.48
65.5	990	5700	0.48	20.0	300	1740	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0067R

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
67.2	970	5810	0.49
68.8	1010	5810	0.48
70.5	1040	5810	0.48
72.1	1020	5700	0.48
74.1	1000	5550	0.48
75.4	1060	5650	0.48
77.0	1030	5750	0.48
78.7	990	5700	0.48
80.3	950	5700	0.49
81.9	950	5750	0.49
83.6	950	5750	0.49
85.2	1000	5810	0.48
86.9	1020	5750	0.48
88.5	1040	5810	0.48
90.1	1100	5750	0.48
91.8	1060	5650	0.48
93.4	1060	5780	0.48
95.1	1060	5630	0.48
96.7	1080	5500	0.48
98.3	1080	5430	0.48
100.0	1060	5480	0.48
101.6	1080	5500	0.48
103.3	1060	5410	0.48
105.2	1070	5390	0.48
106.9	1040	5340	0.48
108.2	1060	5410	0.48
109.8	1060	5410	0.48
111.5	1040	5390	0.48
113.1	1040	5390	0.48
114.7	1050	5410	0.48
116.4	1100	5460	0.48
118.0	1100	5480	0.48
120.0	1120	5500	0.48
121.3	1140	5500	0.48
122.9	1160	5410	0.48
124.6	1130	5500	0.48
126.2	1130	5410	0.48
127.9	1130	5530	0.48
129.5	1100	5630	0.48
131.1	1060	5630	0.48

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
20.5	300	1770	0.49
21.0	310	1770	0.48
21.5	320	1770	0.48
22.0	310	1740	0.48
22.6	310	1690	0.48
23.0	320	1720	0.48
23.5	320	1750	0.48
24.0	300	1740	0.48
24.5	290	1740	0.49
25.0	290	1750	0.49
25.5	290	1750	0.49
26.0	310	1770	0.48
26.5	310	1750	0.48
27.0	320	1770	0.48
27.5	330	1750	0.48
28.0	320	1720	0.48
28.5	320	1760	0.48
29.0	320	1720	0.48
29.5	330	1680	0.48
30.0	330	1660	0.48
30.5	320	1670	0.48
31.0	330	1680	0.48
31.5	320	1650	0.48
32.1	330	1640	0.48
32.6	320	1630	0.48
33.0	320	1650	0.48
33.5	320	1650	0.48
34.0	320	1640	0.48
34.5	320	1640	0.48
35.0	320	1650	0.48
35.5	340	1660	0.48
36.0	330	1670	0.48
36.6	340	1680	0.48
37.0	350	1680	0.48
37.5	350	1650	0.48
38.0	350	1680	0.48
38.5	350	1650	0.48
39.0	340	1690	0.48
39.5	340	1720	0.48
40.0	320	1720	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0067R

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
132.8	1050	5580	0.48	40.5	320	1700	0.48
134.4	1050	5630	0.48	41.0	320	1720	0.48
136.1	1100	5550	0.48	41.5	330	1690	0.48
137.7	1130	5700	0.48	42.0	350	1740	0.48
139.3	1170	5680	0.48	42.5	360	1730	0.48
141.0	1220	5750	0.48	43.0	370	1750	0.48
142.6	1250	5830	0.48	43.5	380	1780	0.48
144.3	1320	5970	0.47	44.0	400	1820	0.47
145.9	1360	5860	0.47	44.5	420	1790	0.47
147.6	1320	5920	0.47	45.0	400	1800	0.47
149.2	1290	5780	0.47	45.5	390	1760	0.47
150.8	1300	5700	0.47	46.0	400	1740	0.47
152.5	1280	5630	0.47	46.5	390	1720	0.47
154.1	1280	5650	0.47	47.0	390	1720	0.47
155.8	1260	5730	0.47	47.5	380	1750	0.47
157.4	1300	5860	0.47	48.0	400	1790	0.47

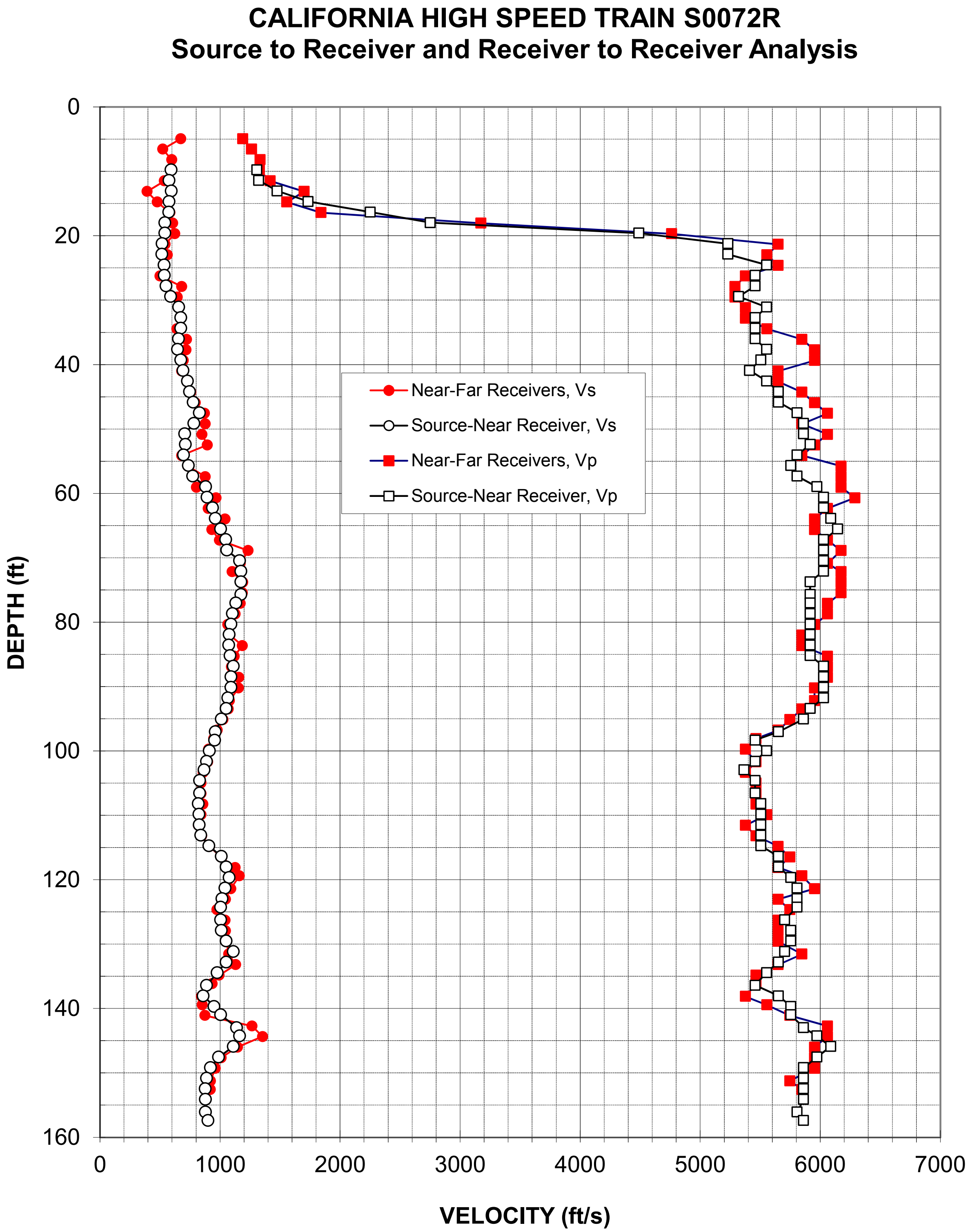

Figure A-3: Boring S0072R, Suspension S-R1 P- and S_H-wave velocities

Table A-3. Boring S0072R, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole S0072R

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
9.8	590	1310	0.37	3.0	180	400	0.37
11.4	580	1320	0.38	3.5	180	400	0.38
13.0	590	1480	0.40	4.0	180	450	0.40
14.7	580	1730	0.44	4.5	180	530	0.44
16.3	570	2250	0.47	5.0	170	690	0.47
18.0	540	2750	0.48	5.5	160	840	0.48
19.6	540	4490	0.49	6.0	160	1370	0.49
21.2	520	5230	0.50	6.5	160	1590	0.50
22.9	520	5230	0.50	7.0	160	1590	0.50
24.5	530	5550	0.50	7.5	160	1690	0.50
26.2	540	5460	0.50	8.0	160	1660	0.50
27.8	550	5460	0.49	8.5	170	1660	0.49
29.4	590	5320	0.49	9.0	180	1620	0.49
31.1	660	5550	0.49	9.5	200	1690	0.49
32.7	670	5460	0.49	10.0	210	1660	0.49
34.4	670	5460	0.49	10.5	210	1660	0.49
36.0	650	5460	0.49	11.0	200	1660	0.49
37.6	650	5550	0.49	11.5	200	1690	0.49
39.3	670	5500	0.49	12.0	210	1680	0.49
40.9	690	5410	0.49	12.5	210	1650	0.49
42.6	730	5550	0.49	13.0	220	1690	0.49
44.2	750	5650	0.49	13.5	230	1720	0.49
45.8	780	5650	0.49	14.0	240	1720	0.49
47.5	830	5810	0.49	14.5	250	1770	0.49
49.1	780	5860	0.49	15.0	240	1790	0.49
50.8	710	5860	0.49	15.5	220	1790	0.49
52.4	710	5920	0.49	16.0	220	1800	0.49
54.0	700	5810	0.49	16.5	210	1770	0.49
55.7	740	5750	0.49	17.0	220	1750	0.49
57.3	770	5810	0.49	17.5	240	1770	0.49
59.0	880	5970	0.49	18.0	270	1820	0.49
60.6	890	6030	0.49	18.5	270	1840	0.49
62.2	940	6030	0.49	19.0	290	1840	0.49
63.9	960	6090	0.49	19.5	290	1860	0.49
65.5	1010	6150	0.49	20.0	310	1870	0.49
67.2	1050	6030	0.48	20.5	320	1840	0.48
68.8	1060	6030	0.48	21.0	320	1840	0.48
70.5	1160	6030	0.48	21.5	350	1840	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0072R

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
72.1	1170	6030	0.48	22.0	360	1840	0.48
73.7	1170	5920	0.48	22.5	360	1800	0.48
75.7	1170	5920	0.48	23.1	360	1800	0.48
77.0	1130	5920	0.48	23.5	350	1800	0.48
78.7	1100	5920	0.48	24.0	340	1800	0.48
80.3	1090	5920	0.48	24.5	330	1800	0.48
81.9	1080	5920	0.48	25.0	330	1800	0.48
83.6	1070	5920	0.48	25.5	330	1800	0.48
85.2	1080	5920	0.48	26.0	330	1800	0.48
86.9	1110	6030	0.48	26.5	340	1840	0.48
88.5	1090	6030	0.48	27.0	330	1840	0.48
90.1	1090	6030	0.48	27.5	330	1840	0.48
91.8	1070	6030	0.48	28.0	320	1840	0.48
93.4	1050	5920	0.48	28.5	320	1800	0.48
95.1	1010	5860	0.48	29.0	310	1790	0.48
97.0	960	5650	0.49	29.6	290	1720	0.49
98.3	960	5460	0.48	30.0	290	1660	0.48
100.0	910	5550	0.49	30.5	280	1690	0.49
101.6	890	5460	0.49	31.0	270	1660	0.49
102.9	870	5360	0.49	31.4	260	1640	0.49
104.6	830	5460	0.49	31.9	250	1660	0.49
106.5	830	5460	0.49	32.5	250	1660	0.49
108.2	820	5500	0.49	33.0	250	1680	0.49
109.8	820	5500	0.49	33.5	250	1680	0.49
111.5	830	5500	0.49	34.0	250	1680	0.49
113.1	840	5500	0.49	34.5	260	1680	0.49
114.7	910	5500	0.49	35.0	280	1680	0.49
116.4	1010	5650	0.48	35.5	310	1720	0.48
118.0	1050	5650	0.48	36.0	320	1720	0.48
119.7	1080	5750	0.48	36.5	330	1750	0.48
121.3	1040	5810	0.48	37.0	320	1770	0.48
122.9	1020	5810	0.48	37.5	310	1770	0.48
124.3	1000	5810	0.48	37.9	310	1770	0.48
126.2	1000	5700	0.48	38.5	310	1740	0.48
127.9	1010	5750	0.48	39.0	310	1750	0.48
129.5	1050	5750	0.48	39.5	320	1750	0.48
131.1	1110	5700	0.48	40.0	340	1740	0.48
132.8	1050	5650	0.48	40.5	320	1720	0.48
134.4	980	5550	0.48	41.0	300	1690	0.48
136.4	890	5460	0.49	41.6	270	1660	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole S0072R

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)	
138.0	860	5650	0.49
139.7	950	5750	0.49
141.0	1000	5750	0.48
143.0	1140	5860	0.48
144.3	1160	5970	0.48
145.9	1110	6090	0.48
147.6	990	5970	0.49
149.2	920	5860	0.49
150.8	890	5860	0.49
152.5	880	5860	0.49
154.1	880	5860	0.49
156.1	880	5810	0.49
157.4	900	5860	0.49

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(m)	(m/s)	(m/s)	
42.1	260	1720	0.49
42.6	290	1750	0.49
43.0	310	1750	0.48
43.6	350	1790	0.48
44.0	350	1820	0.48
44.5	340	1860	0.48
45.0	300	1820	0.49
45.5	280	1790	0.49
46.0	270	1790	0.49
46.5	270	1790	0.49
47.0	270	1790	0.49
47.6	270	1770	0.49
48.0	270	1790	0.49

APPENDIX B

BORING GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION RECORDS

MICRO PRECISION CALIBRATION, INC
12686 HOOVER ST
GARDEN GROVE CA 92841
714-901-5659

Calibration CERT # 935.11

Certificate of Calibration

Date: Jun 18, 2013 **Cert No. 22008120191984**

Customer:
GEOVISION
1124 OLYMPIC DRIVE
CORONA CA 92881

		Work Order #:	LA-90010899
		Purchase Order #:	13161-130607-01
MPC Control #:	BG9698	Serial Number:	15014
Asset ID:	15014	Department:	N/A
Gage Type:	LOGGER	Performed By:	STEVE BORING
Manufacturer:	OYO	Received Condition:	IN TOLERANCE
Model Number:	03331-0000	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 13, 2013
Temp/RH:	71°F / 52 %	Cal. Interval:	12 MONTHS
		Cal. Due Date:	June 13, 2014

Calibration Notes:
See attached data sheet for calculations.
Calibrated IAW customer supplied data form Rev 2.1
Frequency measurement uncertainty = 0.0005 Hz
Unit calibrated with Laptop Panasonic Model CF-29,s/n: 5GKSA39492

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
BD9000	CALIBRATOR	5500A	7375008	FLUKE	Jun 15, 2013	1808504
T1100	COUNTER	53131A	3546A09912	HEWLETT PACKARD	Feb 1, 2014	2200812063530

Procedures Used in this Event

Procedure Name	Description
SUSPENSION PS SEISMIC	Logger/Recorder Calibration Procedure rev2.1

Calibrating Technician: STEVE BORING

QC Approval: Jim Williams

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO 17025:2005, ISO 9001:2008, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

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BG 9698

GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	OYO	Model no.:	3331
Serial no.:	15014	Calibration date:	6/13/2013
By:	Steve Boring	Due date:	6/13/2014
Counter mfg.:	Hewlett Packard	Model no.:	53131A
Serial no.:	3546A09912 (MPC T1100)	Calibration date:	2/1/2013
By:	Micro Precision Calibration	Due date:	2/1/2014
Signal generator mfg.:	Fluke	Model no.:	5500A
Serial no.:	7375008 (MPC BD9000)	Calibration date:	6/15/2012
By:	Micro Precision Calibration	Due date:	6/15/2013
Laptop controller mfg.:	Panasonic	Model no.:	CF-29
Serial no.:	5GKSA39492	Calibration date:	N/A

SYSTEM SETTINGS:

Gain:	10
Filter	LCF: 5Hz; HCF: 20kHz
Range:	See sample period in table below
Delay:	0 ms
Stack (1 std)	1
System date = correct date and time	6/13/2013 10:20

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found -0.12% As left -0.12%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	401	180.0	50.00	179.8	50.06	180.0	50.00
100.0	100.0	100	402	90.00	100.0	90.00	100.0	90.00	100.0
200.0	200.0	50	403	45.00	200.0	45.00	200.0	45.00	200.0
500.0	500.0	20	404	17.98	500.6	18.00	500.0	18.00	500.0
1000	1000	10	405	9.000	1000	9.000	1000	9.000	1000
2000	2000	5	406	4.495	2002	4.500	2000	4.500	2000

Calibrated by:	Steve Boring	6/13/2013	
	Name	Date	Signature
Witnessed by:	Robert Steller	6/13/2013	
	Name	Date	Signature

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.1 February 7, 2012

MICRO PRECISION CALIBRATION, INC
12686 HOOVER ST
GARDEN GROVE CA 92841
714-901-5659

Calibration CERT # 935.11

Certificate of Calibration

Date: Jun 5, 2013 **Cert No. 2200812156209**

Customer:
GEOVISION
1124 OLYMPIC DRIVE
CORONA CA 92881

		Work Order #:	LA-90010807
		Purchase Order #:	13161-130510-01
MPC Control #:	AM6768	Serial Number:	160024
Asset ID:	160024	Department:	N/A
Gage Type:	LOGGER	Performed By:	STEVE BORING
Manufacturer:	OYO	Received Condition:	IN TOLERANCE
Model Number:	3403	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	May 30, 2013
Temp/RH:	71°F / 52 %	Cal. Interval:	12 MONTHS
		Cal. Due Date:	May 30, 2014

Calibration Notes:
See attached data sheet for calculations.
Calibrated IAW customer supplied data form Rev 2.1
Frequency measurement uncertainty = 0.0005 Hz
Unit calibrated with Laptop Panasonic s/n: 6AKSB97198

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
BD7715	UNIVERSAL COUNTER	53131A	3416A05377	HEWLETT PACKARD	Jun 8, 2013	2008120206792
BD9000	CALIBRATOR	5500A	7375008	FLUKE	Jun 15, 2013	1808504

Procedures Used in this Event

Procedure Name	Description
SUSPENSION PS SEISMIC	Logger/Recorder Calibration Procedure rev2.1

Calibrating Technician: STEVE BORING

QC Approval: Jim Williams

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GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	OYO	Model no.:	3403
Serial no.:	160024	Calibration date:	5/30/2013
By:	Charles Carter	Due date:	5/30/2014
Counter mfg.:	Hewlett Packard	Model no.:	53131A
Serial no.:	3416A05377	Calibration date:	6/8/2012
By:	Micro Precision	Due date:	6/8/2013
Signal generator mfg.:	Fluke	Model no.:	5500A
Serial no.:	7375008	Calibration date:	6/15/2012
By:	Fluke	Due date:	6/15/2013
Laptop controller mfg.:	Panasonic	Model no.:	CF-29
Serial no.:	6AKSB97198	Calibration date:	N/A

SYSTEM SETTINGS:

Gain:	2
Filter	10KHz
Range:	See sample period in table below
Delay:	0
Stack (1 std)	1
System date = correct date and time	5/30/2013 -12 hours

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found 0.12% As left 0.12%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	1	179.8	50.06	179.8	50.06	180.2	49.94
100.0	100.00	100	2	90	100	90.1	99.89	90	100
200.0	200.00	50	3	45.05	199.8	45.05	199.8	45	200
500.0	500.00	20	4	18	500	18	500	18	500
1000	1000.00	10	5	9	1000	9	1000	9	1000
2000	2000.00	5	6	4.5	2000	4.5	2000	4.5	2000

Calibrated by: STEVE BORING 5/30/2013 [signature]
Name Date Signature

Witnessed by: Charles Carter 5/30/2013 Charles Carter
Name Date Signature

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.1 February 7, 2012

MICRO PRECISION CALIBRATION, INC
12686 HOOVER ST
GARDEN GROVE CA 92841
714-901-5659

Calibration CERT # 935.11

Certificate of Calibration

Date: Jun 5, 2013 **Cert No. 2200812156204**

Customer:
GEOVISION
1124 OLYMPIC DRIVE
CORONA CA 92881

		Work Order #:	LA-90010807
		Purchase Order #:	13161-130510-01
MPC Control #:	AM6767	Serial Number:	160023
Asset ID:	160023	Department:	N/A
Gage Type:	LOGGER	Performed By:	STEVE BORING
Manufacturer:	OYO	Received Condition:	IN TOLERANCE
Model Number:	3403	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	May 30, 2013
Temp/RH:	71°F / 52 %	Cal. Interval:	12 MONTHS
		Cal. Due Date:	May 30, 2014

Calibration Notes:
See attached data sheet for calculations.
Calibrated IAW customer supplied data form Rev 2.1
Frequency measurement uncertainty = 0.0005 Hz
Unit calibrated with Laptop Panasonic s/n: 6AKSB97198

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
BD7715	UNIVERSAL COUNTER	53131A	3416A05377	HEWLETT PACKARD	Jun 8, 2013	2008120206792
BD9000	CALIBRATOR	5500A	7375008	FLUKE	Jun 15, 2013	1808504

Procedures Used in this Event

Procedure Name	Description
SUSPENSION PS SEISMIC	Logger/Recorder Calibration Procedure rev2.1

Calibrating Technician: STEVE BORING

QC Approval: Jim Williams

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GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	OYO	Model no.:	3403
Serial no.:	160023	Calibration date:	5/30/2013
By:	Charles Carter	Due date:	5/30/2014
Counter mfg.:	Hewlett Packard	Model no.:	53131A
Serial no.:	3416A05377	Calibration date:	6/8/2012
By:	Micro Precision	Due date:	6/8/2013
Signal generator mfg.:	Fluke	Model no.:	5500A
Serial no.:	7375008	Calibration date:	6/15/2012
By:	Fluke	Due date:	6/15/2013
Laptop controller mfg.:	Panasonic	Model no.:	CF-29
Serial no.:	6AKSB97198	Calibration date:	N/A

SYSTEM SETTINGS:

Gain:	2
Filter	10KHz
Range:	See sample period in table below
Delay:	0
Stack (1 std)	1
System date = correct date and time	5/30/2013 +/-< 1 minute

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

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Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	6	180	50	179.8	50.06	180	50
100.0	100.00	100	5	90	100	90	100	90.1	99.89
200.0	200.00	50	4	45.05	199.8	45	200	45	200
500.0	500.00	20	3	17.98	500.6	18	500	18	500
1000	1000.00	10	2	9	1000	9.01	998.9	9	1000
2000	2000.00	5	1	4.495	2002	4.5	2000	4.5	2000

	Name	Date	Signature
Calibrated by:	STEVE BORING	5/30/2013	S. Boring
Witnessed by:	Charles Carter	5/30/2013	Charles Carter

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.1 February 7, 2012